

Article

# Challenges in the Digitization of Apprenticeships during the Coronavirus Pandemic: Who Needs Special Assistance?

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**Abstract:** The COVID-19 pandemic has affected all areas of life, including everyday working life. Apprentices are often affected two-fold by the lockdown—school closures make it difficult to learn the theoretical content, while restrictions in the company affect practical work. This article reports the findings of an online mixed-method survey among 167 apprentices on the impacts of the pandemic on dual vocational training in Germany. In the survey, Likert scales were presented visually in a way that was particularly suitable for adolescents. The results show that the schools have had gaps in terms of equipment and online instruction. There was little or no online teaching, and the apprentices had hardly any contact with teachers and were left to work on the material on their own. The majority of apprentices expected their school performance to deteriorate as a consequence of the pandemic. The individual comments in response to open-ended questions also suggest that the digital offerings of vocational schools were inadequate during the first lockdown. At the same time, there were major differences in individual hardware equipment, such as computers, and in the apprentices' Internet access. The gender differences are particularly interesting, as women tended to be at a disadvantage.

**Keywords:** COVID-19 pandemic; school-closure; apprenticeship; digital teaching; live communication



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## 1. Introduction

Since its onset in 2020, the global spread of the coronavirus has fundamentally changed lives. One serious policy measure that has been undertaken to limit the spread of the coronavirus has been school closures. In Germany, the first school closures began in mid-March 2020, resulting in a switch from face-to-face classes to distance learning, without a period of transition. In the best cases, teaching took place digitally; however, in addition to media-competent teachers [1], this also required sufficient access to digital media and an adequate Internet connection for students, and these conditions were not met in every household [2].

Prior to the coronavirus pandemic, the main focus for promoting digitization was on the students' digital skills and the school infrastructure, whereas digital equipment at home played a subordinate role [3]. Due to this insufficiency, the question arises as to what extent digital instruction took place during the first school closure and the extent to which students were adequately equipped for digital distance learning. In addition, it is important to investigate whether certain groups of people are less equipped than others, which may lead to (increasing) educational inequality [3,4]. This raises the additional question of the extent to which there are gender differences. It has already been shown that technical equipment is a major challenge in distance learning for students at general education schools [5]. The proportion of lower-performing students is especially high among students with insufficient technical equipment [6].

Despite the above, there have been only a few studies that have focused on apprentices who are students at vocational schools as part of their dual vocational training. Apprentices

learn both in a special vocational school and in a company, meaning they are students and employees at the same time. They, therefore, experience a double burden, which cannot be fully deduced from previous studies on students on the one hand and employees on the other. At present, it is still largely unclear how the pandemic will affect their particular learning and working situation and to what extent this will result in particular challenges for them.

The aim of this paper is to provide an overview of how vocational school teachers implemented digital teaching during the first school closure, what the technical equipment used by the young people was like, and whether there were different consequences in terms of academic performance for certain groups. As such, this paper contributes substantially to narrowing the research gap, while providing an initial overview and recommendations for supporting apprentices in their particular employment situation, in addition to presenting aspects for future research. Data collected as part of the research project “Successful Start into the Apprenticeship” (Erfolgreicher Start in die Berufsausbildung, EStarA) by the University of Applied Labor Studies at the Mannheim Campus were analyzed based on the following research questions: “What is the situation at German vocational schools for apprentices engaged in the dual system during the coronavirus pandemic? To what extent is the digitization of instruction successfully implemented in this context?” The data relate to the period of the first school closure in Germany, and in addition to a standardized questionnaire, open-ended statements made by the apprentices are included. First, the theoretical foundations of digital learning are outlined and a reference to the special situation of the coronavirus pandemic is made. Then, the specifics of the survey group of young people, as well as the collected data and methods of analysis, are discussed. The descriptive statistics for the quantitative elements and the qualitative results are then reported. Finally, these results and their limitations are discussed and an outlook is provided.

## 2. Theoretical Background

### 2.1. Digital Learning

Apprentices are mostly young people, who before the pandemic received close support from vocational schools and contact persons in companies.

The coronavirus pandemic caused school closures. Learning took place independently at home using digital devices, while the situation in companies also changed due to contact restrictions. The apprentices, therefore, had to learn on their own and without being tied to a specific location, i.e., the vocational school or the company. On the other hand, digital learning offers advantages.

Due to the technical possibilities and the large amount of information available on social media, learning and communication behaviors have been changing dynamically in recent years. Digital media and online platforms generally enable informal learning, which compared to formal learning, is not tied to an institution. Online teaching formats offer a combination of these types of learning, enabling structured and guided learning without being directly tied to a physical space. This allows a high degree of spatial flexibility. An associated challenge, however, is the high level of personal responsibility of the learners and the adaptation to media-supported and self-directed learning that must be mastered, which requires further competencies with regard to digital learning media [7].

Only a few of the training companies introduced digital devices along with the contact restrictions, while 65% refused to do so, as Biebeler and Schreiber [8] reported in a study by the Federal Institute for Vocational Education and Training in Germany. The use of digital media for learning is also rarely implemented but varies greatly by sector. The authors point out that handicraft professions also offer a great deal of potential for digital media due to the complex cognitive learning processes involved, which also goes beyond the pandemic situation.

In summary, digital devices and media offer opportunities for learning that increased relevance during the pandemic, although it is still largely unclear to what extent these are used and available to apprentices.

## 2.2. Importance of the Learning Space

A particular challenge posed by the pandemic and school closures is the organization of the personal learning space. When instruction takes place online, learning must be organized in a different location. During the first school closure, apprentices studied exclusively at home. In terms of space, three dimensions are relevant to the personal learning environment: the material environment, the formal environment, and the adopted environment. The material environment is based on the space itself and the associated benefits and deficits, particularly the technical infrastructure and necessary room features, such as sufficient size and available daylight. The formal environment describes the framework conditions, such as the predefined rules of conduct, time, and organizational structures (for example, timetables and breaks). The adopted environment includes the individual linking of people, spaces, and available resources to create an identity. Through the combination of these dimensions, a personal learning space develops that includes other elements, such as the support of other people present [9]. Due to online communication during the coronavirus pandemic, the technical equipment and consequently the material environment increased in relevance. In order to be able to communicate with the vocational school and learn successfully, a well-equipped learning space is of great importance.

In addition, the contact restrictions mean that important personnel resources are lacking in both the social environment of the vocational schools and through supervisors in the companies.

Accordingly, the apprentices experience a substantial change in their familiar learning environments in both learning spaces.

## 3. Current State of Research

### 3.1. Digitization in Dual Vocational Training

The dual vocational training system in Germany focuses on strong practical orientation through simultaneous training at learning locations in companies and in vocational schools. Both areas are closely intertwined but show clear differences with regard to the implementation of ongoing digitization.

Klös et al. [10] emphasized the relevance of the close interconnection between ongoing digitization and vocational training in companies. In this context, they referred to the dynamic links of theoretical training content with the changed business processes of companies through digital subject content and digital teaching. With reference to the IW Personnel Panel 2020, the authors reported that training companies had a higher average level of digitization than companies that did not offer vocational training and that interest in digital training content has been on the rise in recent years. The results of an entrepreneur survey by Flake et al. [11] also confirmed the high level of interest among training companies in the digital alignment of business processes.

A 2018 survey collected data from 383 academics, politicians, and practitioners on the topic of apprenticeship and examined the requirements for future-oriented development of vocational schools in the dual training system in Germany on the basis of 18 topics. Digitization emerged as the most important topic. Strengthening vocational schools as partners of training companies was also perceived as an important goal, ranking in fourth place. The authors emphasized that successful cooperation between schools and companies is important to enable high-performance vocational training [12].

Neuburg et al. [13] referred to these results and suggested that schools and companies should only be considered in combination in order to provide the best possible support for existing digital options. The authors referred to learning cooperation based on logbooks, which represent a form of documentation of training content in Germany. Since 2010, these can also be produced online as a portfolio, implemented through a government-funded

research project; however, the results of the study on the use of this free service showed that in 2019, only 807 of a total of 8770 vocational schools nationwide were registered for the digital service [13].

These results show that the implementation of digitization is currently low and that the use of digital services in vocational schools is varied. Against the backdrop of the coronavirus pandemic, this issue is becoming increasingly important.

### 3.2. First School Closure during the Coronavirus Pandemic

Due to the first nationwide school closure, classes were held digitally, if at all. To participate, apprentices needed appropriate equipment, including digital devices. In addition, it was necessary to have access to a sufficient Internet connection. A qualitative survey of young people during the pandemic showed that despite the availability of digital devices, there are access problems because too many people in the household use the Internet at the same time during the pandemic [14]. Restrictions also arise in companies, the practical place of learning for apprentices. HR managers in apprenticing companies reported that the pandemic has led to operational restrictions and knowledge gaps for apprentices, because not all activities can be transferred to working from home [15]. A study by Ebbinghaus [16] showed that in fall 2020, 25% of apprenticing companies implemented working from home. Against the backdrop of the nationwide recommendation to comprehensively implement working from home in companies, this low percentage is particularly striking.

Changes also occurred at vocational schools. At the beginning of this first school closure, clear differences in the implementation of classroom organization could be observed. In a qualitative interview study, vocational school teachers from Germany reported that before the start of the pandemic, only special tablet classes used online learning platforms, while many of the students did not have access to these digital learning opportunities. The scope and frequency of the distribution of learning materials also varied widely [17]. Some vocational schools provided only photocopies, while others used digital learning materials [18]. Due to the federal structure, there are also strong regional differences in legal regulations for the design of teaching during the pandemic [19].

A study from Finland reported that overall student motivation decreased during school closures and students reported excessive workloads and difficulty concentrating during distance learning [20]; however, social differences between students, such as social background [21], have also been a factor in school success during the pandemic. A specific example is access to digital devices, which became particularly relevant during the pandemic. Using PISA data from 21 European countries, González-Betancor et al. [4] showed that access to ICT (information and communication technology) is influenced by the socioeconomic status of parents. This means that parents with a higher socioeconomic status are more likely to provide their children with access to ICT.

Mauroux et al. [22] examined the use of an online learning platform. Important determinants of usage were device availability, willingness to use the platform, and interest in using smartphones in general, as well as high acceptance of the learning platform and the desire for feedback from the instructor. In addition to socioeconomic background, gender also has an impact on digital learning. In terms of the general use of computers and the Internet, boys have an advantage. A study with data from 39 countries showed that generally boys used computers at home more often than girls in most countries. Likewise, boys used computers and the Internet more often for educational purposes [23].

Conversely, a study of Austrian secondary school students showed that girls were more committed to digital learning, received more support from teachers, and were more intrinsically motivated [24]. Within the particular context of online learning during school closures, gender differences in the use of technical equipment can, therefore, be assumed.

Hansen and Plank [25] argued that the simultaneous closure of schools and other public facilities, such as libraries, during the coronavirus pandemic has put a particular focus on household resources in terms of creating an efficient learning environment. Considering this, the authors pointed out that this may exacerbate already existing educational

inequalities for socially disadvantaged students. This is reflected by differences in support opportunities, technical equipment, and language acquisition for families with a migration background. The Berufsbildungsbericht (Vocational Education and Training Report) 2020 pointed out significant differences among immigrant youth depending on their country of origin. For example, young people of Turkish origin in particular have difficulty finding an apprenticeship and are disproportionately represented among those who have not completed an apprenticeship [26].

Moreover, Hansen and Plank [25] generally saw a risk in expecting high self-regulation from students. With regard to the theoretical argument of the relevance of developing a sustainable personal learning space in online learning opportunities, this point is particularly crucial. In a study in Lower Austria, Tengler et al. [5] reported that from teachers' perspectives, the biggest challenge for distance education during the pandemic has been technical equipment, followed by poor time management and students being overloaded. Digital media contributes significantly to the success of learning during school closures, although not all students can receive the same support as before the pandemic-related school closures. An evaluation of teaching showed a focus on the use of asynchronous media, such as e-mail, textbooks, and printed worksheets. Interactive formats, such as Teams and Moodle, were used less frequently. Only 52% of teachers surveyed based their instruction on videoconferencing. A study of a socioeconomic panel with data from Germany up to 2018 showed that academic performance was particularly related to the spatial conditions of the home learning environment and identified higher support in academic families [6,27].

These results also support assumptions about the personal learning environment and underline the importance of the materials and appropriate learning space dimensions in terms of technical devices and additional resources provided by support persons. Based on data from students' households reported by the National Educational Panel Study (NEPS), analyses indicated that the use of conventional media, such as books, has not changed in frequency due to the pandemic; however, the use of digital learning opportunities with virtual interactive features has increased overall and is particularly high in academic families [28]. There is already evidence of a deterioration in academic performance in Germany since the start of the pandemic due to a reduction in learning time [29] and deterioration in math and German performance in skills tests [30]. A comprehensive literature review by Zierer [31] also concluded that school closures in the United States, Belgium, the Netherlands, Switzerland, and Germany have caused a decline in math and language skills since the beginning of the pandemic, despite differences in methodology.

Overall, these results suggest that even before the start of the pandemic, socially disadvantaged students with poor technical equipment and an inadequately designed learning environment performed worse than students benefiting from support in academic households. This disparity is particularly relevant due to the school closures and the shift of learning to the home environment, which are associated with a lack of contact with teachers and resources relevant for learning. In addition to subject knowledge, this also affects basic skills, such as math and language competencies, which are of central importance for success at school and later in a career.

There is also a clear research gap. Specifically, for apprentices in Germany who are students at a vocational school as part of their theoretical training, only one study by the Deutscher Gewerkschaftsbund (DGB, German Federation of Trade Unions) has been performed to date. This study revealed parallels to the aforementioned studies on other types of schools, particularly with regard to the technical equipment in the schools, the quality of teaching, and difficulties with the subject matter in distance learning, as well as gender differences in the perception of examination preparation by the company or school [32]. The study did not consider the technical equipment available to the apprentices or the extent to which school closures had changed their academic performance. In addition, for apprentices there is a double burden of two learning locations (the school and company) during school closures, which needs to be examined in more detail.



## 4. Data and Method

### 4.1. Challenges by Surveying Adolescents

When surveying adolescents, who make up a high proportion among apprentices, some special features have to be taken into account. On the one hand, in order to achieve high data quality, surveys in the household context should be avoided due to negative effects caused by the presence of parents [33]. On the other hand, the school context also leads to problems due to the perception of an examination situation and social desirability bias [34,35]. In addition, it is particularly important to use simple and easy-to-understand language and to make sure that the questions are formulated in direct relation to the adolescents' own experience [34]. Likewise, the presentation of the questions is important for response behavior [36].

Online questionnaires offer the possibility of integrating digital visual elements, which improves the data quality among adolescents [37]. This is especially true for rating scales, which involve the difficulty of classifying one's own assessment on a numerically oriented scale. Previous studies have shown that symbols are particularly suitable for the visualization of expressions [38,39]. At the same time, the target group in this study also provides advantages; specifically, the high use of mobile devices among adolescents increases their willingness to participate in online surveys [40].

### 4.2. Data

To examine the impacts of the first vocational school closure during the coronavirus pandemic in Germany, this study used primary data from the EStarA project. The survey period covered eight weeks between October and December 2020. Conducting the survey shortly after the school closure reduced bias due to memory gaps. The study design was aligned with the target group of young people. In order to meet the challenges of surveying young people, data collection took place in cooperation with the chambers that supervise the apprentices.

#### 4.2.1. Respondents

The respondents were apprentices taking part in dual vocational training in southern Germany. Due to the sampling method, the study is not representative for Germany. The selection of respondents was not random, but was carried out in cooperation with three selected chambers in southern Germany in order to increase the motivation to participate and to reduce context effects: Heilbronn-Franken Chamber of Industry and Commerce, Heilbronn-Franken Chamber of Handicrafts, and Palatinate Chamber of Handicrafts. The chambers received instruction on the questionnaire and were equipped with display cleaner pads for smartphones as incentives for the apprentices, as well as printed data protection declarations from the HdBA. This document included a note that no personal data would be surveyed and referred to the data protection officer of the HdBA.

#### 4.2.2. Survey Design and Data Collection

The computer-assisted self-interview (CASI) questionnaire was completed in training centers, and the apprentices were given an unrestricted time frame by the chambers for this purpose. In addition, the questionnaire was optimized for smartphones to allow implementation on the apprentices' own devices. The language was oriented toward simple and short sentences with clear references to the topic. In addition, visual elements supported the assessment of statements using rating scales through graphically illustrating response options. Appendix A shows the original German scale and an English translation based on an example from the questionnaire. The questionnaire included quantitative content with closed questions as well as qualitative aspects to allow free-text comments to be added to individual topic blocks. The data set comprised 167 apprentices from southern Germany.

#### 4.2.3. Measures

For this paper, sociodemographic characteristics and rating scales on the apprenticeship situation were analyzed. Three items dealt with the situation at the vocational school. The apprentices rated on a fully verbalized 5-point scale the extent to which their concerns were taken seriously by the vocational school, the extent to which the teachers used digital media for live communication, and the extent to which the vocational school already used digital media before the pandemic. In addition, two questions on technical equipment were examined using the same scale. Here, the apprentices indicated the extent to which they had enough computers, laptops, and tablets available at home and the extent to which there was a sufficiently fast Internet connection. An item on the expected effects on academic performance was finally analyzed, with the response categories being “improve”, “do not change”, “worsen”, and “partly/partly available”.

#### 4.3. Method

Descriptive statistics were used for the evaluation of the quantitative content in order to investigate the apprentices' perceptions in an explorative way. To identify group differences, grouped graphs were used in addition to significance tests and Cohen's *d* effect sizes. The analyses were performed with SPSS Statistics 27.

For the evaluation of the qualitative parts on the basis of the open comments, MAXQDA software was used. The qualitative content analysis was used as a guideline for the interpretations. The procedure was initially deductive and theory-driven, based on the topics in the questionnaire. Since the qualitative questions were also used to explore areas not covered in the standardized questionnaire, categories were subsequently added using an inductive approach, such as the area of tension between the vocational school and the company. These codes were also subcoded in order to be able to structure and summarize the information more specifically. The information was summarized and categorized, whereby the categorization was based on the one hand on the originally superordinate topic blocks, and on the other hand on an inductive derivation, which led to partial cross-question coding.

A total of 255 open answers were given in the survey. Of these, 172 comments with meaningful content were included in the analysis and 179 text segments were coded. The 179 codings were subdivided into six superordinate categories with 15 subcodes.

The 93 open responses relevant to this article were assigned to the categories “digital school”, “difficult learning conditions”, and “tension between vocational school and company”.

### 5. Quantitative Results

#### 5.1. Sociodemographics

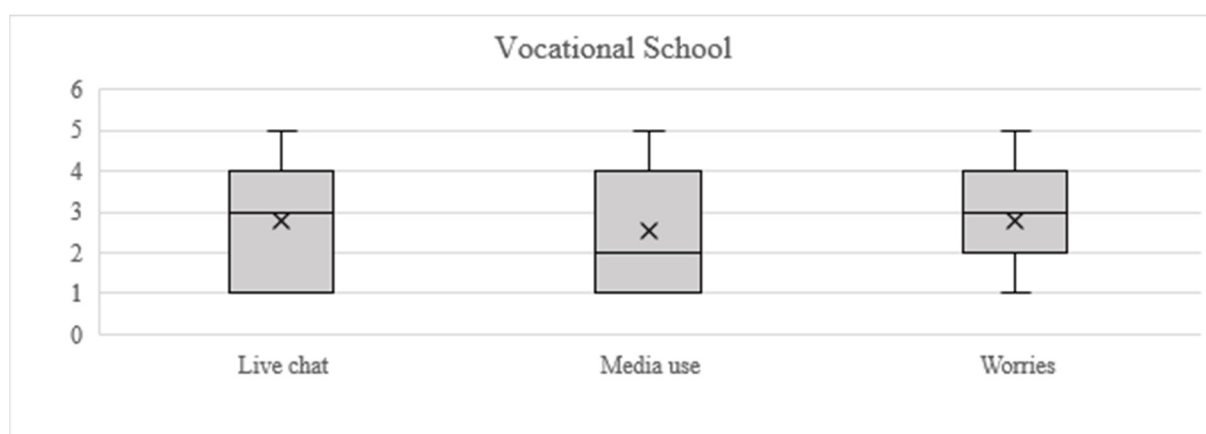
Table 1 summarizes the relevant socioeconomic data for the apprentices. The average age in the sample was 19.74 years, with an average variance of 3.08 years. The sample included apprentices between 16 (minimum age to participate) and 35 years of age. At 80.9%, the majority of apprentices were male, 17.2% were female, and 1.9% reported a diverse gender. For the gender analyses, due to the small number of cases and low significance, this category was omitted, while the focus was on a comparison of women and men. With regard to education, the majority of apprentices had an intermediate secondary school certificate (57.42%), followed by 30.97% with a lower secondary school certificate; 6.45% had a university of applied sciences entrance qualification, 2.58% had a general university entrance qualification, and 2.58% of the respondents did not have a secondary school diploma. Another relevant sociodemographic factor is the mother tongue, which was German for 80.2% of the apprentices and another language for the remaining 19.8%.

**Table 1.** Sociodemographic data.

Sociodemographic Data	Scale	Modus	Median	Mean
Age	In years min: 16; max: 35	19	19	19.74 −3.08
Gender	Male Female Diverse	1		80.90% 17.20% 1.90%
School diploma	No secondary school diploma Lower secondary school certificate Intermediate secondary school certificate University of applied sciences entrance qualification General university entrance qualification	3	3	2.58% 30.97% 57.42% 6.45% 2.58%
Mother tongue	German Other language	1		80.20% 19.80%

### 5.2. Changes in the Situation in the Vocational School

The first relevant question dealt with how the situation at the vocational school was perceived by the apprentices. Figure 1 uses a boxplot to show the apprentices' assessment of the use of live communication during the school closure, general media use, and perceived support during the school closure. A boxplot is particularly suitable for these data, because in addition to the mean, the distribution of the statements can also be seen. The cross in the middle of the box represents the mean value, while the median (50%) is indicated by the horizontal bar. The box shows the distribution of the apprentices' statements and is bounded by the first (25%) and third quartiles (75%). Longer boxes show higher heterogeneity. The whiskers typically reflect the minimum and maximum data for the respondents, unless extreme values are present. If these values are present in marginal areas, the whiskers represent the data outside the quartile limits, and extreme values are highlighted as dots.

**Figure 1.** Boxplot showing the organization of the vocational schools.

Using a rating scale (1–5), apprentices rated the extent to which instructors used live communication during the school closure, with higher scores indicating greater use. The mean score was 2.72, while the standard deviation was 1.44 scale points. Half of the apprentices reported a maximum value of 3, with the upper quartile (75%) reporting a value of 4 and the lower quartile (25%) reporting a value of 1. The first quartile in particular, representing a value of 1, indicated that a quarter of the apprentices reported that no live communication was used, representing exclusively asynchronous teaching.

The question on general media use, including before the pandemic, showed a low use of digital media in vocational schools. The mean was 2.55 (SD = 1.34) and the first quartile



was at a value of 1, meaning the teachers did not use digital media in the vocational schools to design the lessons. The median was 2, showing low media use. In summary, the data on media use were in the lower to middle range, showing a clear potential for improvement.

The third box in Figure 1 represents the extent to which teachers recognized the concerns of apprentices during the school closure, with higher values representing greater attention to concerns. The mean was 2.8, the standard deviation was 1.33 scale points, and the distribution of responses was more homogeneous than that regarding media use. Among respondents, 25% of the apprentices indicated a value of 2 and 75% reached a maximum value of 4. According to these values, the recognition of apprentices' worries was in the middle range.

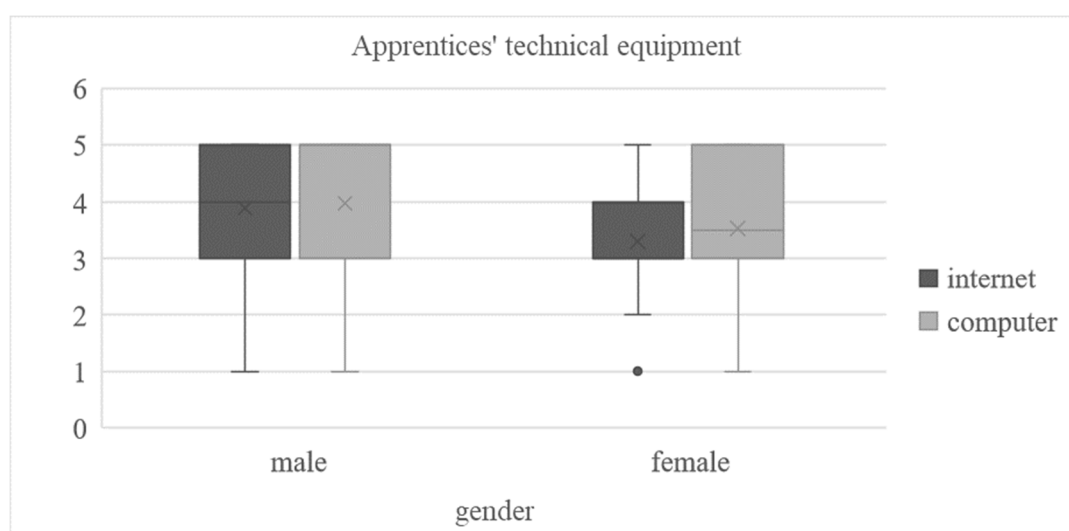
### 5.3. Digital Equipment Available to Apprentices

The second relevant issue in this paper is the individual technical equipment available to the apprentices. This represents a central factor for successful participation in vocational training during school closures and is, therefore, of great importance for the success of training. Table 2 shows relevant descriptive statistics for the variables related to the apprentices' own technical equipment, separated by gender. In addition, the results of a t-test are presented to show group differences and statistical significance based on the p-value and the effect size (Cohen's d) of the difference in means. According to Cohen [41], an effect of 0.2 or greater is considered small, 0.5 or greater is considered medium, and 0.8 or greater is considered large. Figure 2 shows the corresponding boxplots. Higher values indicate better computer equipment or a better Internet connection.

**Table 2.** Descriptive statistics for technical equipment available to the apprentices.

	N	Mean	SD	$p\Delta$ *	Cohen's d
Computer					
male	117	3.97	1.417	0.147	0.317
female	26	3.54	1.174		
Internet					
male	117	3.90	1.269	0.029 *	0.478
female	26	3.31	1.050		

\* Statistically significant at a level  $<0.05$ .



**Figure 2.** Boxplot for technical equipment available to the apprentices—gender differences.

The results in Table 2 show that the average scores for female apprentices in both areas were lower than those of male apprentices. With regard to terminal equipment, such as computers, laptops, or similar, women achieved a mean score of 3.54, while men were

significantly higher at 3.97; however, the effect was not statistically significant, even though the differences can be seen clearly on the basis of the effect size. This may be due to the small number of cases and the high standard deviations, which showed that there was a high degree of heterogeneity in the technical equipment available to the apprentices, as is also evident from the lengths of the boxes in the graph.

Figure 2 shows that the pattern described above was also found for Internet connections. The mean value for women was 3.31, while for men it was again higher at 3.90, and the effect was statistically significant at the 95% level (two-sided *t*-test). With an effect size of 0.478, which is considered a medium effect size, this result suggests significant differences in Internet use and computer equipment between genders.

#### 5.4. Change in School Performance

The third issue related to the students' assessment of the consequences of school closure as a result of the pandemic and the accompanying performance expectations. Overall, 30.4% of the apprentices stated that they fear a deterioration in performance. While 26.1% expected no change in performance due to the situation during the pandemic, 22.5% indicated that they expected their performance in the vocational school to improve; however, the high percentage of those who expected a change, either positive or negative, suggests group differences. Some of the apprentices appeared to be more affected than others by the school changes and challenges resulting from the pandemic. Gender and language differences are explored in more detail below.

Table 3 presents gender differences in expected performance changes using cross-tabulation with row percentages to reflect the different numbers of cases in the gender distribution in the data set. Figure 3 shows these row percentages graphically.

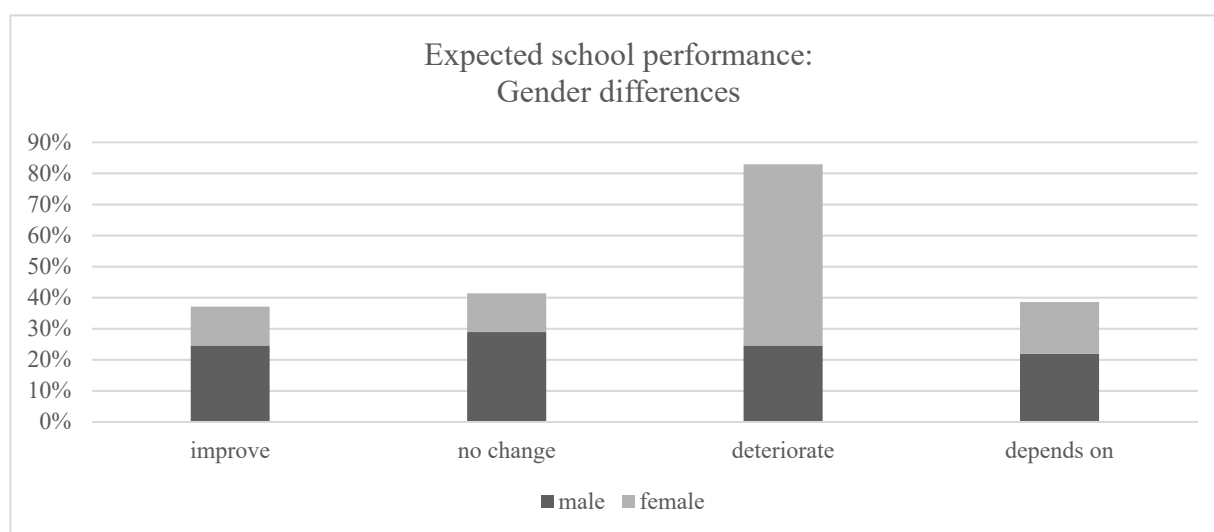
**Table 3.** Cross-table of expected school performance and gender parameters.

			Improve	No Change	Deteriorate	Depends on	Total
Gender	male	frequency	28	33	28	25	114
		% of gender	24.6%	28.9%	24.6%	21.9%	100.0%
	female	frequency	3	3	14	4	24
		% of gender	12.5%	12.5%	58.3%	16.7%	100.0%
Total		frequency	31	36	42	29	138
		% of gender	22.5%	26.1%	30.4%	21.0%	100.0%

Note: The gender differences are significant (chi-square statistic  $p = 0.012$ ).

Table 3 shows that only 12.5% of the women expected an improvement in performance. In contrast, more than twice as many (24.6%) male apprentices said that they expected an improvement. In addition, 28.9% of the men, again more than twice as high for women, stated that they did not expect any changes, whereas this was the case for 12.5% of the women; however, the proportion of women was significantly higher in the group of apprentices who feared a deterioration in performance, which can also be clearly seen in the proportions of the bars in Figure 3. At 58.3%, the majority of women expected their school performance to deteriorate as a result of school closure during the pandemic. This proportion was twice as high as that for men (24.6%).

A chi-square test comparing the expected cell frequencies within the cross-tab due to the marginal distribution with the actual frequencies in the sample indicated that the gender differences are statistically significant at the 95% level. In summary, a large proportion of women reported fearing deterioration, while most of the men expected no change and equal proportions expected improvement or deterioration. Consequently, women seemed to be affected to a significantly greater extent by changes in vocational schools in terms of expected deterioration in performance, appearing to particularly suffer from these challenges.



**Figure 3.** Stacked bar chart of expected school performance—gender differences.

As can be seen in Table 4, the mother tongue of 80.2% of the respondents was German. At 8.4%, the proportion of apprentices whose mother tongue is Turkish was the largest among the foreign languages; therefore, for the following comparison, differences in performance changes are examined using these two groups as examples.

**Table 4.** Frequency rates of various mother tongues.

Mother Tongue	Absolute Frequency	Proportion in Percent
German	134	80.2
Albanian	4	2.4
Arabic	1	0.6
Italian	2	1.2
Khmer	2	1.2
Croatian	1	0.6
Kurdish	3	1.8
Polish	1	0.6
Portuguese	1	0.6
Romanian	1	0.6
Russian	3	1.8
Turkish	14	8.4
Total	167	100.0

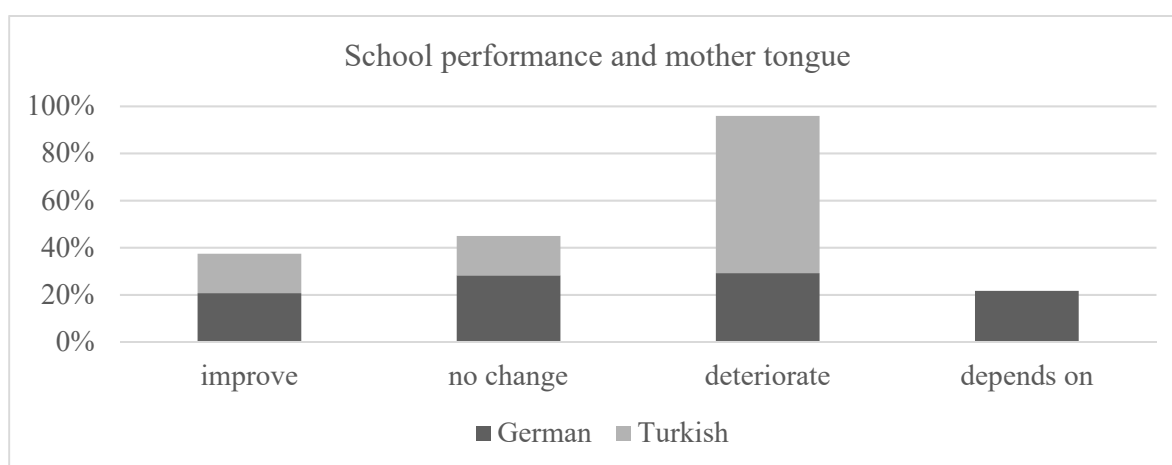
Table 5 shows the cross-tabulation between German and Turkish mother tongues and the expected deterioration in school performance, which is shown graphically in Figure 4. While 29.2% of apprentices with a German mother tongue feared a deterioration in performance, the figure for those with a Turkish mother tongue was 66.7%. This pattern is also evident with regard to the expected improvement: 16.7% of Turkish-speaking apprentices expected their performance to improve, compared with 20.8% of German-speaking apprentices (see also Figure 4).

The chi-square test revealed significant group differences between apprentices with German and Turkish mother tongues, but only at a significance level of 90%. It should be noted, however, that the number of cases of Turkish-speaking apprentices is very small. In summary, these analyses indicate a significant disadvantage for apprentices with Turkish mother tongue with respect to the expected change in academic performance due to the pandemic.

**Table 5.** Cross-table of expected school performance and mother tongue parameters.

			Improve	No change	Deteriorate	Depends on	Total
Gender	German	frequency	22	30	31	23	106
		%	20.8%	28.3%	29.2%	21.7%	100.0%
	Turkish	frequency	2	2	8	0	12
		%	16.7%	16.7%	66.7%	0.0%	100.0%
Total		frequency	24	32	39	23	118
		%	20.3%	27.1%	33.1%	19.5%	100.0%

Note: The mother tongue differences are significant (chi-square statistic  $p = 0.050$ ).

**Figure 4.** Stacked bar chart of school performance—differences by mother tongue.

## 6. Qualitative Results

In addition to the results described above, the respondents had the opportunity to provide open-ended responses to the various topics. In particular, the aspect of tension between the vocational school and company during school closure is new and was not included in the closed questions. Some responses reaffirmed the answers to the closed questions, particularly with regard to the schools' digital equipment and the apprentices' own digital equipment. This indicates that the topic is highly relevant to these adolescents.

Table 6 shows a selection of related statements made by the apprentices. These have been translated from German, but reflect the original content.

Two open-ended questions were relevant for further examination:

"Do you have any further comments on your own technical equipment, the organization in the school, and the technical equipment in the vocational school?"

The responses indicated a lack of technical equipment at vocational schools, as well as a lack of online teaching. Some apprentices questioned the success of their learning due to the lack of digital instruction during the first school closure. Teaching content exclusively by e-mail is not sufficient for young people to successfully complete the school-based part of their apprenticeship.

"Do you have any other comments about the impact of the coronavirus pandemic on your academic performance that you would like to share with us?"

In responses to this question, it is evident that during the first school closure, digital teaching of the learning content was absent or insufficient and that the apprentices lacked contact with the teachers for their instruction. The provision of learning materials for individual learning was mostly dilatory, which is why the apprentices lacked a large amount of learning materials. It took some time to switch from face-to-face instruction to other forms of learning, and the apprentices were unable to easily adjust to distance learning because they were not used to self-organized learning. In addition, some apprentices

described tension between the school and company; in the regular course of vocational training, it is clearly specified that apprentices are given time off of work for vocational school classes, but this was not true for all companies during the school closure. Some companies did not give their apprentices time off for their vocational school days during this period because there was no classroom instruction. The apprentices, thus, had to work in the company at all times. This meant that the apprentices did not have the time they needed to learn the school content on their own.

**Table 6.** Selected statements of the qualitative analysis.

<b>Technical equipment and the organization in the vocational school</b>	
-	Bringing vocational schools up to date with the latest technology.
-	The teachers assumed that everyone had a computer, printer, etc., at home. They often did not understand when a student could not afford such a thing.
-	We seem to have been given new laptops by the school that almost never work. And many students can not participate in class and have to connect with the cell phone.
-	Too many different programs are used. Some of them are rather experimental and often do not work very well.
-	Not enough material to be able to work from home.
<b>Impact on academic performance</b>	
-	Learning at home is not as efficient as learning at school. At school, the possibility to ask questions again is better than via email.
-	The online classes work very poorly because I can't teach myself the topics.
-	You can see that the teachers expect the student to study at home as well as at school. But there are subjects that only a person teaching the subject can explain to us, and not a book. Also, teachers want to follow their curriculum without compromise, no matter if someone is behind in learning or doesn't understand something right away.
-	I wasn't given time off by the company for home school days and then didn't keep up with the class material.
-	Lots of class content has been left out that you have to study on your own.

Overall, in the open responses, the apprentices indicated that the first school closure has had a negative impact on their school performance.

## 7. Conclusions

### 7.1. Summary

The aim of this paper is to provide an overview of changes in vocational schools in Germany during the coronavirus pandemic. The focus is on the implementation of digital teaching by vocational schools. In addition, challenges for the apprentices as well as their technical equipment are examined in more detail.

With regard to the situation at the vocational schools, there is clear potential for improvement in the general use of media and the organization of lessons with the help of live communication. One-quarter (25%) of the apprentices stated that teachers did not use live communication and that lessons took place exclusively asynchronously. This confirms the findings by Tengler et al. [5], who also reported insufficient use of interactive communication formats during school closure. The authors additionally identified significant differences in terms of external support and technical capabilities, which is also confirmed in the present analyses.

Overall, the technical equipment available to the apprentices was inadequate in terms of available Internet connection and technical devices at the time of the first school closure. Many of the apprentices indicated a lack of technical devices and an insufficient Internet connection in the quantitative questions. In addition, the data revealed significant gender differences. Male apprentices had significantly better Internet connections than female apprentices. Men also had an advantage with respect to technical devices, but the mean difference was not statistically significant for this aspect. One possible reason for the difference in technical equipment could be gender differences in personal interest in technology [23]. Students with a high level of interest are likely to have already been equipped with technical devices before the school closure. In addition, a higher level of



technical interest promotes a general willingness to use online learning opportunities [22], which can have a positive effect on performance, particularly during the absence of face-to-face teaching. The open comments also suggest that from the apprentices' perspectives, schools were not sufficiently technically equipped to offer good online lessons.

In terms of performance, few apprentices expected an opportunity for improved performance as a result of the pandemic; a much higher proportion feared a deterioration in performance; however, there were strong gender differences. The majority (58%) of women were concerned that their academic performance will deteriorate, whereas only 26.6% of men had this fear. This finding is also supported by a study conducted by the DGB Youth and Youth Policy Department [32], which revealed clear gender differences when apprentices were asked whether they felt well-prepared for exams by the vocational school or the company. The disadvantages observed among women in terms of technical equipment, which is strictly necessary to participate in online lessons during school closures, suggest that this lack of equipment is also reflected in concerns about a deterioration in performance. These factors are particularly relevant during school closures, since they are necessary to adequately follow classes and ensure a consistent level of performance.

The results of the comparative analyses also revealed clear and statistically significant disadvantages for apprentices whose mother tongue is Turkish. Given that Turkish apprentices have more difficulty finding a vocational training position in the first place and are also more likely to lack school-leaving diplomas [26], the additional impact of the pandemic on this group has been particularly severe. Another challenge arises in the abrupt change in the learning space. Hansen and Plank [25] emphasized the impacts of the simultaneous closure of schools and relevant facilities for learning, such as libraries, as well as the resulting challenge of self-organization, and pointed to the particular burden on families with immigrant backgrounds. Accordingly, the disadvantages of native Turkish speakers identified in this paper were severe in terms of feared deterioration in performance. The open-ended responses underscored the findings on feared deterioration in academic performance and provided insights into the reasons for the fears; in addition to technical equipment and the lack of online teaching, the lack of time to learn the content is essential. Likewise, self-organized learning appears to be a difficulty. In summary, for most apprentices, the absence of face-to-face instruction goes hand-in-hand with a significant drop in performance. A lack of cooperation between the company and the vocational school also has a negative impact on learning success and makes self-organized learning more difficult. In addition, the results point to increasing educational inequality.

## 7.2. Discussion

### 7.2.1. Practical Implications

In summary, initial practical implications can be drawn from the results. First, the technical equipment was not always sufficiently available. The handling of the technical devices and the use of the software also led to problems. In addition, gender differences can be observed, requiring a gender-sensitive approach to this topic. Teachers can take this into account when designing their lessons in the future. Teräs [42] recommends that the use of digital technologies should be integrated more strongly into teacher education.

Second, independent learning is challenging for apprentices. A lack of practice also results in problems due to potential language barriers, which can be reduced by using special support programs. In general, it can also be stated that the promotion of self-learning competence is becoming more relevant as a result of the pandemic. This must be further strengthened in order to successfully take advantage of the opportunities offered by digital learning and to benefit from both. On the one hand, digital learning platforms facilitate the understanding of complex learning content and promote transferability into practice, while on the other hand, the spatial and temporal independence increases the flexibility of learning.

Third, communication between apprentices and the vocational schools on the one hand and familiar contact people in the companies on the other are important to sup-

port apprentices in the learning process. Lopez-Saldana [42] points out the relevance of developing new technologies and didactic approaches.

Last but not least, a clear area of tension in relation to the focus of this study shows the double burden on the apprentices. They are students and employees at the same time and get into role conflicts due to a lack of coordination. Interaction and communication between vocational schools and training companies were difficult during the first school closure, leading to increased workloads and a lack of support options. Institutional exchange must be improved in the future through clear structures in order to reduce the burden on apprentices, because both learning environments are of great importance for successful apprenticeships.

#### 7.2.2. Limitations and Future Research

These results should be interpreted with caution. Due to methodological problems, the following limitations of the analyses are apparent. The survey was conducted with the support of selected chambers in southern Germany, some of which were affected by ordered closures during the survey period. Consequently, the sample is limited to a regionally small area, and only a small number of apprentices could be recruited for the survey. In addition, the sample is selective, showing significant differences from the greater population in both the proportion of women and in the occupational groups that participated in the survey. Due to these limitations, this survey is not representative, which is why the results do not allow conclusions to be drawn about the situation for all apprentices [43]. This limitation also applies to the open-ended responses, which were given voluntarily by only some of the participants. Consequently, not all views are represented in the open-ended responses, which is why no generalizations are possible. The qualitative part of the survey should, therefore, be seen as complementary to the quantitative responses with a hypothesis-generating character. Above all, the comments can provide clues for developing interesting questions for further surveys.

Moreover, the data are a retrospective recording of the apprentices' impressions and assessments of the situation during the first school closure, which may have led to biases [44].

Limitations also arise from the question construction. The assumptions regarding the influence of the mother tongue on educational success cannot be examined in more detail because the survey only asked about the mother tongue but not about which language is actually spoken at home, and whether for example there are German-speaking support persons who are of great importance in terms of shaping the acquired learning space [9]. Likewise, the actual interest in IT technology was not queried, meaning gender-specific conclusions could not be drawn. Furthermore, the quantitative analyses in this paper are descriptive; they provide an initial overview, but not a concrete hypothesis test.

Future analyses can provide more detailed links between the personal network, individual interests, and technical disadvantages, as well as any deterioration in performance. This will require the construction of a specific questionnaire as well as a comprehensive sample.

Furthermore, how the situation is reflected in the second school closure and the extent to which changes in technical equipment have taken place are highly relevant topics for future research.

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## Appendix A

**Jetzt geht es um die Organisation der Berufsschule.**  
Bitte geben Sie jeweils an, inwieweit die Aussagen auf Sie/Ihre Berufsschule zutreffen.

	trifft nicht zu	trifft eher nicht zu	teils/ teils	trifft eher zu	trifft zu	kann ich nicht beurteilen
Meine Sorgen wurden während der Schulschließung von der Schule ernst genommen.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Die Lehrerinnen und Lehrer nutzten Live-Kommunikation (z.B. Video-Chat) während der Schulschließung, um sich mit den Schülerinnen und Schülern auszutauschen.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wir arbeiten seit längerer Zeit in der Schule mit digitalen Medien.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure A1. Original German scale.

**Now it's about the organisation of the vocational school.**  
Please indicate in each case to what extent the statements apply to you/your vocational school.

	does not apply	tends not to apply	neutral	tends to apply	applies	I cannot assess
My worries were taken seriously by the school during the closure.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Teachers used live communication (e.g., video chat) during the school closure to communicate with students.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
We have been working with digital media at school for quite some time.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure A2. English translation of the original German scale.

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